F·A·A·M facility for airborne atmospheric measurements

FLIGHT FOLDER

Flight No.:	B087
Date:	30 Mar 2005
Take Off	10:01:10
Landing:	14:17:00
Flight Time	4h15m50

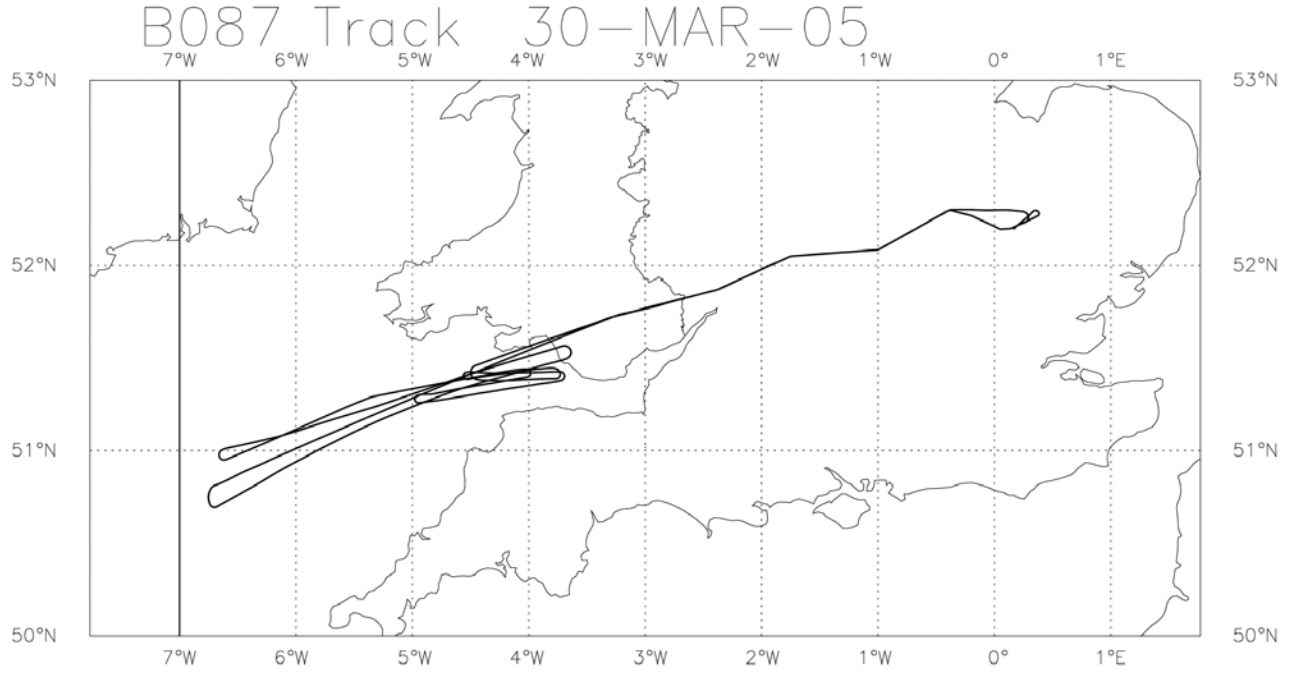
Campaign: CHEMISTRY 2005 TEST FLIGHT 1

Trials Instructions: The aim of this sortie is to test the instruments before the beginning of this summer's flying.

Operating Area: Bristol Channel, S.W. Approaches (Area Alpha)

POB	Position	Name	Institute
1	Captain	Alan Foster	Directflight
2	Co-pilot	Ian Ramsay-Rae	Directflight
3	Mission Scientist	Claire Reeves	UEA
4	ADA/CPI & Mission Scientist (training)	Keith Bower	University of Manchester
5	Mission Scientist (training)	Hugh Coe	University of Manchester
6	ADA/CPI & Mission Scientist (training)	Martin Gallagher	University of Manchester
7	Flight Manager	John Reid	FAAM
8	Flight Manager (training)	Alan Woolley	FAAM
9	Core Chemistry	Ruth Purvis	FAAM
10	Core Chemistry / CCM2	Doug Anderson	FAAM
11	Cloud Physics	Paul James	FAAM
12	Cloud Physics (training)	Jamie Trembath	FAAM
13	AMS	Paul Williams	University of Manchester
14	PTrMS	Dave Oram	UEA
15	NOxy	David Stewart	UEA
16	Peroxide	Brian Bandy	UEA
17	CCM	Sue Angold	Directflight
18			
19			
20			

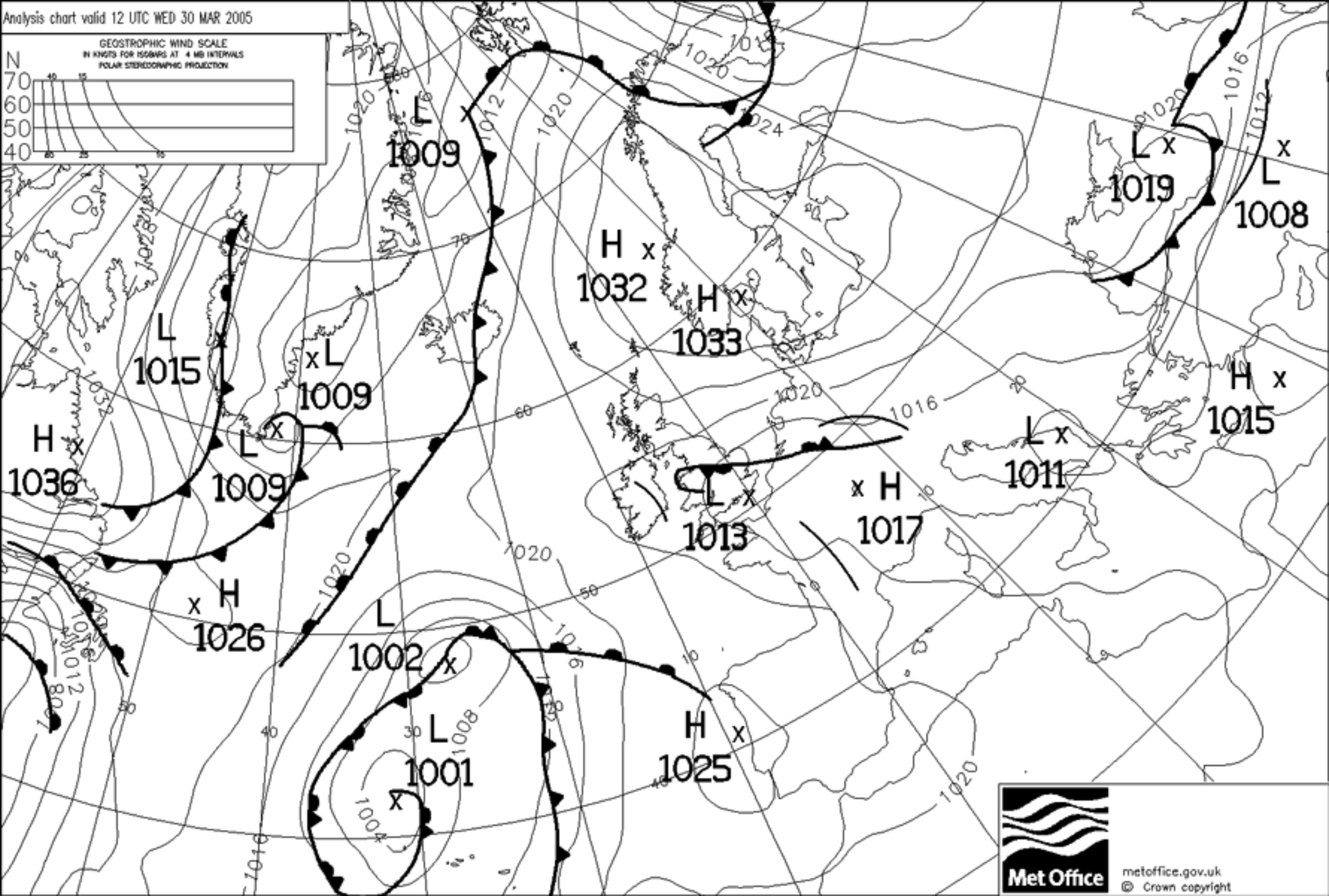
Flight Track:



FLIGHT SUMMARY

Flight No B087
Date: 30/03/05
Project: Test Flying
Location: Bristol Channel

Start Time	End Time	Event	Height (s)	Hdg	Comments
095107		inu to nav	0.04 kft	210	
100110		Take-off			From Cambridge
100633		Air Sample Open			
101551	101807	Run 1	4.0 kft	264	
102556	104437	Run 2	14.0 kft	243	
104646	110649	Profile 1	14.0 - 1.2 kft	091	
105209		Profile 1	8.0 kft		interrupted
105357		Profile 1	8.0 kft	272	resumed
110103		Profile 1	3.0 kft	264	interrupted
110246		Profile 1	3.0 kft	085	resumed
111221	112225	Run 3	1.2 kft	263	
112246	112526	Profile 2	1.2 - 2.2 kft	264	
112657	113659	Run 4	2.3 - 2.2 kft	080	
113831	115032	Profile 3	2.3 - 10.0 kft	272	
115040	120531	Run 5	10.0 kft	261	
120712	121752	Profile 4	10.0 - 20.0 kft	070	
121753	123157	Run 6	20.0 kft	071	
123401	124144	Profile 5	20.1 - 28.0 kft	252	
124144	125152	Run 7	28.0 kft	256	
125152	130905	Profile 6	28.0 - 15.0 kft	253	
130033		profile 6	20.0 kft	253	interrupt
130330		Profile 6	20.0 kft	053	resumed
130906	134013	Run 8	15.0 kft	063	
134013	134933	Profile 7	15.0 - 5.0 kft	078	
140721		Air Sample Closed			
141700		Land			At Cambridge
142409		aircraft at standstill 207 52'12.55N, 0'10.45E			


Analysis chart valid 12 UTC WED 30 MAR 2005
GEOSTROPHIC WIND SCALE
IN KNOTS FOR ISOBARS AT 4 MB INTERVALS
POLAR STEREOGRAPHIC PROJECTION
N
70
60
50
40
L 1009
H 1032
H 1033
L 1019
L 1008
L 1015
L 1009
H 1036
L 1009
H 1026
L 1002
L 1001
H 1025
L 1013
H 1017
L 1011
H 1015
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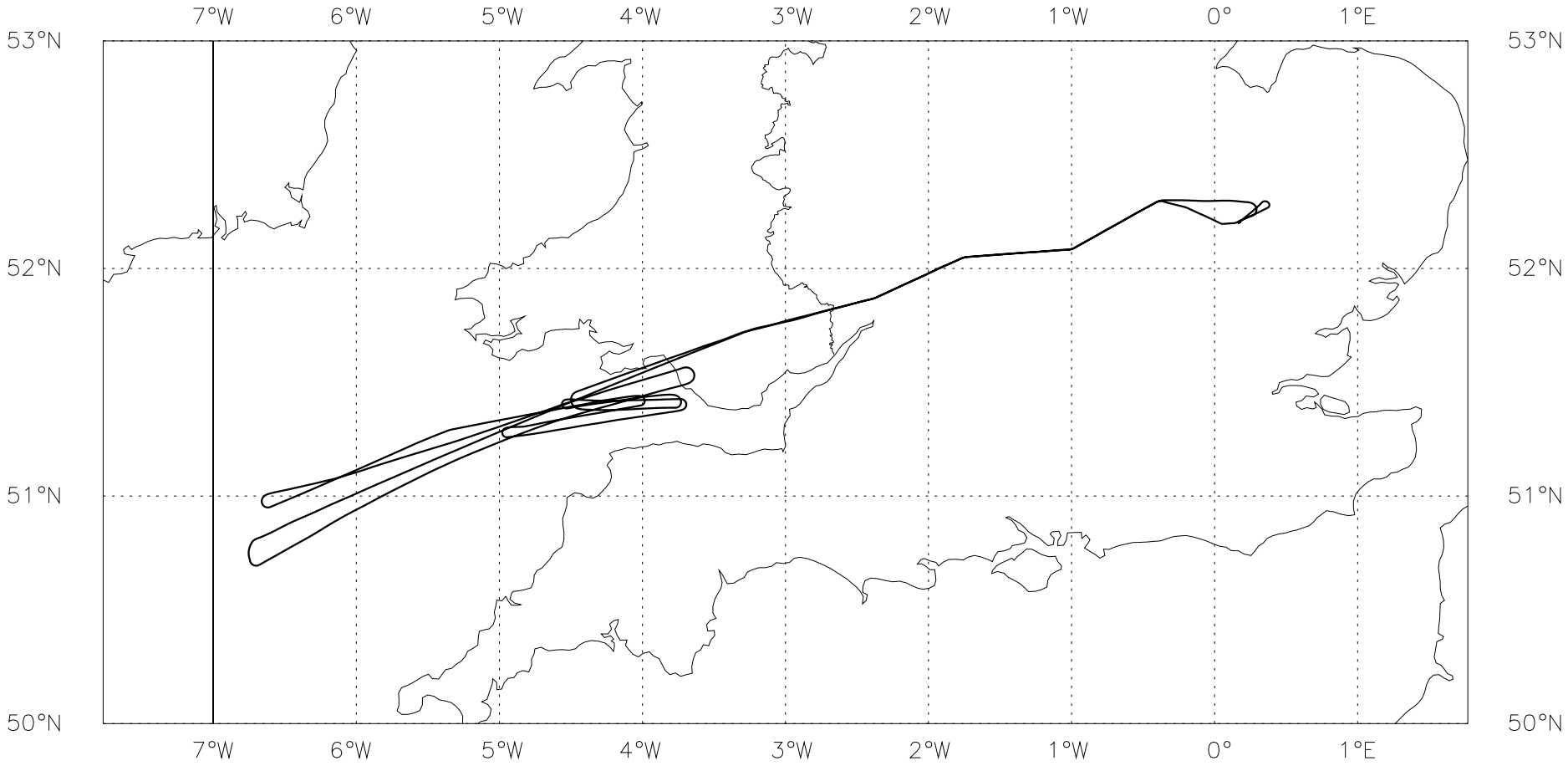
B087 Track 30-MAR-05



B087: Pre-Summer 2005 Flying - Test Flight 1.

Mission Scientist: Claire Reeves

Date: 30/03/05

Outline schedule:

07:00 - Power to aircraft – Warm-up
09:00 - Briefing
10:15 - Security check and boarding
10:30 - Aircraft doors close
11:00 - Take Off (from Cambridge)
15:00 - Land (at Cambridge)
15:30 - Debrief
17:00 - Aircraft returns to Cranfield – power available until then

Location: Bristol Channel, S.W. Approaches (Area Alpha)
Alternative location (depending on cloud): N. Sea (Area Echo).

Aim

The aim of this sortie is to test the instruments before the beginning of this summer's flying. To do this we require straight and level runs at a range of altitudes (1000ft to FL300), mostly cloud free, although a couple of runs in cloud would also be useful. Also some runs in polluted air are required and this will be attempted in the boundary layer off the coast of S. Wales.

Sortie Detail

1. T+0 Take Off. Ascend to first available level for wet chemistry checks. (10)
2. T+10 Transit to operating area. This should include at least 20 mins at constant altitude in clear air between FL100 and FL150 for calibration purposes. (30)
3. T+40 Profile descent to 1000ft at 1000ft/min above 5000ft and 500ft/min below. (15)
4. T+55 Straight and level run at 1000ft (15)
5. T+70 Profile ascent to next level at 500ft/min below 5000ft and 1000ft/min above (10).
6. T+80 Straight and level run at selected level (15)
7. T+95 Repeat 5 and 6 four times (100)
8. T+195 Profile descent at 1000ft/min to transit altitude (FL100-FL150) (15)
9. T+210 Transit to Cambridge to include at least 20mins at constant altitude (FL100-FL150) for calibration purposes (30)
10. T+240 Land at Cambridge.

Comments for debrief.

1. - transit at alt suitable for NOxy calc.
   - unloading cylinders etc.
   - problem hearing pilots - intermittent
   - instrument status - NOxy NOy2 channel?
     - peroxide - mass flow controller.
     - ground height., AOA.
     - CO flags?
2. - time the details of brief are lodge with ATC.

1 nb ≈ 30 ft at low alts.
- colour printing. - from MS laptop
- MS laptop - - standby + hibernate kept settings + any open windows programs.
  - turn off lost all saved plots.

3. - Back day tomorrow needs
4. a Flight Friday? - details
   b. crew? instruments

more detail.

Flight 8087. Ted Flight 1. 30.8.05

Summer 2005 flying.

Time	Run/Profile (Alt)	Remark
10:01:10	T/o.	P. 1014 Cloud up to + beyond 4000ft. - alt held continued up to 5000ft - held ≈ 5 mins descend back to 4000ft
10:15:51	R1. 5000ft. up to FL070 up to FL140	held at FL070 - still cloud. out of cloud at FL110 although layer above
10:25:56	R2 FL140	Turn towards at end.
10:34.4.	end	
10:46:46	P1. FL40-1000ft end 11:06	Entering cloud @ ? Thin cloud at FL100 (C. unc. 2350 ft. 2000 ft. C. unc to 6000ft clear air at 3000ft. (intermpt. Swansea broken cloud at 1000ft. cloudy.
	1200ft	
11.12	R3 1200ft	cloudy to north
11:22:25	end Run	undercast. 11:19 (or before)
11:22:46	P2	
11:26:57	R4 2300ft	odd patches of cloud.
11:36:59	end.	
11.38.31	P3 → FL100	clear up to
	FL100	clear

Time	Run/Prof/(Alt)	Remark
	PL200	clear
	PL280	clear
	PL150	clear · some cloud just at end of run
	PL050	cloud

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5. T+70 Profile ascent to next level at 500ft/min below 5000ft and 1000ft/min above (10).
6. T+80 Straight and level run at selected level (15)
7. T+95 Repeat 5 and 6 four times (100)
8. T+195 Profile descent at 1000ft/min to transit altitude (FL100-FL150) (15)
9. T+210 Transit to Cambridge to include at least 20mins at constant altitude (FL100-FL150) for calibration purposes (30)
10. T+240 Land at Cambridge.

- 4 miles/minute
  change with alt.

- Noisy single cal!?

FLIGHT NUMBER	B087	DATE:	30/3/05	OPERATOR:	RMP
PROJECT:	Chemistry test flight				

CORE CHEMISTRY PRE FLIGHT LOG

PRE POWER UP	
All sample lines are connected to the rack	OK
All cylinders pressures are OK	OK
Ozone Span = 504, Offset = 50	OK

GAS PRESSURES	N_2 (bar)	CO_2 / Argon (bar)	CO standard (bar)
PRE FLIGHT	50	150	130
POST FLIGHT			

POST POWER UP - GROUND				
Ozone Sample Flow 1 (LPM)	**Ozone Sample Flow 2 (LPM)**	**NO_x Sample Flow (LPM)**	**NO_x Ozonator Flow (LPM)**	**SO_2 Sample Flow (LPM)**
0.5	**0.5**	**0.069**	**1.119**	**0.483**
CO Time check against HORACE	**CO Lamp Flow (ml/min)**	**Pressure Monochromator (bar)**	**Pressure Cell (Torr)**	
SAME	**34.02**	**1.37**	**6.60**	

ZEROS							Average
Ozone (ppbV)	**-1**	**0**	**-1**	**0**	**0**	**-1**	**0**
NO (ppbV)	**0.36**	**0.38**	**0.41**	**0.35**	**0.3**	**0.24**	**0.34**
NO_2 (ppbV)	**5.68**	**5.48**	**5.2**	**4.96**	**4.61**	**4.57**	**5.08**
NO_X (ppbV)	**6.04**	**5.87**	**5.61**	**5.25**	**4.9**	**4.81**	**5.41**
SO_2 (ppbV)	**-0.73**	**-0.04**	**-0.48**	**-0.77**	**-1.13**	**-0.2**	**-0.56**

PRE FLIGHT COMMENTS
Flow on the lamp gas and pressures on the CO monitor were fluctuating **Laptop power connector not working in port number one** **Had to turn up monochromator pressure to maintain cell pressure – not usual**

FLIGHT NUMBER	B087	DATE:	30/3/05	OPERATOR:	RMP
PROJECT:	Chemistry test flight				

CORE CHEMISTRY CALIBRATION AND FLOW LOG

PREVIOUS CO CAL	Date and Flight Level	Sensitivity (Hz/ppbV)	Bkgrd (ppbV)	Bkgd Cnt R (Hz)
	Unknown	91.08	81.23	7398.02

Time	Flight Level	CO					
		Sensitivity (Hz/ppbV)	Bkgrd (ppbV)	Bkgd Cnt R (Hz)	Lamp Temp (°C)		Cell Press (Torr)
094215	Ground	72.92	102.97	7509.38	50		6.99
		Flows (LPM unless stated)					
		CO Lamp Gas (ml/min)	Ozone Sample 1	Ozone Sample 2	NO_X Sample	NO_X Ozonator	SO_2 Sample
		34.01	0.5	0.5	1.114	0.068	0.483
Time	Flight Level	CO					
		Sensitivity (Hz/ppbV)	Bkgrd (ppbV)	Bkgd Cnt R (Hz)	Lamp Temp (°C)		Cell Press (Torr)
	4000ft	79.84	117.29	9365.04			6.37
		Flows (LPM unless stated)					
		CO Lamp Gas (ml/min)	Ozone Sample 1	Ozone Sample 2	NO_X Sample	NO_X Ozonator	SO_2 Sample
Time	Flight Level	CO					
		Sensitivity (Hz/ppbV)	Bkgrd (ppbV)	Bkgd Cnt R (Hz)	Lamp Temp (°C)		Cell Press (Torr)
103638	FL140	85.36	149.20	12735.32	49		6.92
		Flows (LPM unless stated)					
		CO Lamp Gas (ml/min)	Ozone Sample 1	Ozone Sample 2	NO_X Sample	NO_X Ozonator	SO_2 Sample
		33.87	0.5	0.5	1.088	0.067	
Time	Flight Level	CO					
		Sensitivity (Hz/ppbV)	Bkgrd (ppbV)	Bkgd Cnt R (Hz)	Lamp Temp (°C)		Cell Press (Torr)
110944	1200ft	81.69	150.49	12293.70			
		Flows (LPM unless stated)					
		CO Lamp Gas (ml/min)	Ozone Sample 1	Ozone Sample 2	NO_X Sample	NO_X Ozonator	SO_2 Sample
Time	Flight Level	CO					
		Sensitivity (Hz/ppbV)	Bkgrd (ppbV)	Bkgd Cnt R (Hz)	Lamp Temp (°C)		Cell Press (Torr)
	2000ft	80.90	149.69	12109.21	50		7.15
		Flows (LPM unless stated)					
		CO Lamp Gas (ml/min)	Ozone Sample 1	Ozone Sample 2	NO_X Sample	NO_X Ozonator	SO_2 Sample
		33.84	0.5	0.5	1.086	0.067	0.456

FLIGHT NUMBER	B087	DATE:	30/3/05	OPERATOR:	RMP
PROJECT:	Chemistry test flight				

CORE CHEMISTRY CALIBRATION AND FLOW LOG

Time	Flight Level	CO				
		Sensitivity (Hz/ppbV)	Bkgrd (ppbV)	Bkgd Cnt R (Hz)	Lamp Temp (°C)	Cell Press (Torr)
115444	FL100	81.41	142.13	11570.62	50	7.13
		Flows (LPM unless stated)				
		CO Lamp Gas (ml/min)	Ozone Sample 1	Ozone Sample 2	NO_X Sample	NO_X Ozonator	SO2 Sample
		33.91	0.6	0.7	1.069	0.067	0.456
Time	Flight Level	CO				
		Sensitivity (Hz/ppbV)	Bkgrd (ppbV)	Bkgd Cnt R (Hz)	Lamp Temp (°C)	Cell Press (Torr)
	FL200	77.86	188.89	14707.32	50	7.15
		Flows (LPM unless stated)				
		CO Lamp Gas (ml/min)	Ozone Sample 1	Ozone Sample 2	NO_X Sample	NO_X Ozonator	SO2 Sample
		33.93	0.8	0.8	1.026	0.066	0.358
Time	Flight Level	CO				
		Sensitivity (Hz/ppbV)	Bkgrd (ppbV)	Bkgd Cnt R (Hz)	Lamp Temp (°C)	Cell Press (Torr)
124437	FL280	56.07	414	23211	50	6.41
		Flows (LPM unless stated)				
		CO Lamp Gas (ml/min)	Ozone Sample 1	Ozone Sample 2	NO_X Sample	NO_X Ozonator	SO2 Sample
		33.93	0.8	0.8	0.990	0.065	0.146
Time	Flight Level	CO				
		Sensitivity (Hz/ppbV)	Bkgrd (ppbV)	Bkgd Cnt R (Hz)	Lamp Temp (°C)	Cell Press (Torr)
	FL200	73.79	194.48	14350.41	50	6.86
		Flows (LPM unless stated)				
		CO Lamp Gas (ml/min)	Ozone Sample 1	Ozone Sample 2	NO_X Sample	NO_X Ozonator	SO2 Sample
		33.87	0.8	0.8	1.041	0.066	0.262
Time	Flight Level	CO				
		Sensitivity (Hz/ppbV)	Bkgrd (ppbV)	Bkgd Cnt R (Hz)	Lamp Temp (°C)	Cell Press (Torr)
	FL150	79.18	149.82	11863.67		
		Flows (LPM unless stated)				
		CO Lamp Gas (ml/min)	Ozone Sample 1	Ozone Sample 2	NO_X Sample	NO_X Ozonator	SO2 Sample

FLIGHT NUMBER	B087	DATE:	30/3/05	OPERATOR:	RMP
PROJECT:	Chemistry test flight				

CORE CHEMISTRY FLIGHT LOG

GENERAL COMMENTS

SO2 quite variable and started to read below zero
CO took a while to reboot
ASP opened 100600 ASP closed 1406
Co cell pressure will not hold - had to increase nitrogen
NOX box values all 1ppbV too high
Inpolluted level NOx about 7.29 ppbV
SO2 flow drops at FL150 monitor becomes US
FL240 cap on vent
CO data US Run 7 → 1306
Did long zero on run 8 to try and improve background
Increasing nitrogen increases the background so now a plausible solution

CLOUD PHYSICS LOG

Flight No. B087 **Date: 30/03/05** **Operator: JT** **Page 1 of**

G.M.T.	PCASP		FSSP	SID1	2D2-C			2D2-P			Remarks
DRS Time	Conc/cc	Mean R	Block Transfer	Particle Count	Conc/L	Max Size	Habit	Conc/m3	Max Size	Habit	
10:15:55	867	0.1						141			
17	660	0.1			0.5			100			10:18:07 end of run 1
10:25:57	8.75	0..07			0	0	0	0	0	0	
10:26	20.27	0.07									
10:28	10	0.7									
10:29	8	0.08									
10:30	5	0.06									
10:31	13	0.07									
10:32	15	0.07									
10:33	12	0.07									
10:34	20	0.07									
10:35	20	0.07									
10:36	25	0.07									
10:37	18	0.08									
10:38	28	0.07									
10:39	28	0.07									
10:40	15	0.07									
10:41	22	0.07									
10:42	25	0.08									
10:43	28	0.07									
10:44	6.5	0.07									
10:45											10:44:37 end of run 2
10:46:46	8	0.07			0	0	0	0	0	0	Profile decent
10:47	11	0.07									
10:48	35	0.07									
10:49	130	0.07									
10:50	200	0.07									
10:51	200	0.07									
											Decent interupted at fl80 10:52:09

CLOUD PHYSICS LOG

Flight No. B **Date:** **Operator:** **Page 2 of**

G.M.T.	PCASP		FSSP	SID1	2D2-C			2D2-P			Remarks
DRS Time	Conc/cc	Mean R	Block Transfer	Particle Count	Conc/L	Max Size	Habit	Conc/m3	Max Size	Habit	
10:54:57	190	0.07									Decent recommenced
10:55	170	0.08									
10:56	263	0.39			18	100	2	158			
10:57	100	O.07			40	275					
10:58	30	0.1			0	0	0	0	0	0	
10:59	830	0.79									
											Decent interupted 3000ft 11:01:03
11:03	2091	0.12									Profile recommenced
11:04	1350	0.11									
11:05	1400	0.12									
11:06	1600	0.12									
11:07											End profile decent 1200ft 11:06:09
11:12:21	1702	0.1			0	0	0	0	0	0	Start run 3 1200ft
11:13	1700	0.1									
11:14	1800	0.1									
11:15	1900	0.11									
11:16	1700	0.11									
11.17	1800	0.12									
11:18	2100	0.12									
11:19	2500	0.12									
11:20	2600	0.12									
11:21	2600	0.12									
											End of run 112225
11:22:46	1800	0.12			0	0	0	0	0	0	112246 start of profile climb 1200ft
11:23	2500	0.11									
11:24	2100	0.13									
11:25											Profile climb end 2300ft 11:25

CLOUD PHYSICS LOG

Flight No. B **Date:** **Operator:** **Page 3 of**

G.M.T.	PCASP		FSSP	SID1	2D2-C			2D2-P			Remarks
DRS Time	Conc/cc	Mean R	Block Transfer	Particle Count	Conc/L	Max Size	Habit	Conc/m3	Max Size	Habit	
11:27:56	2030	0.13			0	0	0	0	0	0	Start of run 4 2300ft
11:28	2400	0.12									
11:29	1100	0.12									
11:30	1700	0.12									
11:31	800	0.12									
11:32	950	0.15									
11:33	1220	0.17									
11:34	700	0.16									
11:35	550	0.16									
11:36	400	0.16									
11:37											End of run 11:36:59
11:38:40	234	0.3			5	300	1				Start of profile ascent 2300ft
11:39	40	0.13			0	0	0	0	0	0	
11:40	18	0.25			13	275	1	500			
11:41	12	0.13			0	0	0	0	0	0	
11:42	5	0.13									
11:43	7	0.15									
11:44	20	0.15									
11:45	120	0.18									
11:46	115	0.16									
11:47	30	0.16									
11:48	15	0.15									
11:49	10	0.15									
11:50											End of profile ascent 11:50:32 fl100
11:50:32	10	0.16									Start of run 5 10,000ft
11:51	14	0.16									
11:52	11	0.16									
11:53	14	0.16									
11:54	15	0.17									
11:55	14	0.16									

CLOUD PHYSICS LOG

Flight No. B **Date:** **Operator:** **Page 4 of**

G.M.T.	PCASP		FSSP	SID1	2D2-C			2D2-P			Remarks
DRS Time	Conc/cc	Mean R	Block Transfer	Particle Count	Conc/L	Max Size	Habit	Conc/m3	Max Size	Habit	
11:56	10	0.17									
11:57	11	0.17									
11:58	7.5	0.19									
11:59	5	0.18									
12:00	8	0.2									
12:01	0	0									Flow appear to OK (12:01:55)
12:02											
12:03											
12:04											
1205	0	0									
120531											End run 5
12:07:30	0	0			0	0	0	0	0	0	Start profile ascent fl100 –fl200
12:08											
12:09											
12:10											
12:11											
12:13											
12:14											PCASP turned off and on again
12:15											No change in data but flow
12:16											responded to Pump being turned off
12:17											
12:18											
12:18:00	0	0			0	0	0	0	0	0	Start run 6 20000ft
											End of run 12:31:57
12:34:01	0	0			0	0	0	0	0	0	Profile 5 climb 20000ft
12:41:44											Profile 5 end 28000ft
12:41:44	0	0			0	0	0	0	0	0	Start run 7
12:51:52											End run 7

CLOUD PHYSICS LOG

Flight No. B **Date:** **Operator:** **Page 5 of**

G.M.T.	PCASP		FSSP	SID1	2D2-C			2D2-P			Remarks
DRS Time	Conc/cc	Mean R	Block Transfer	Particle Count	Conc/L	Max Size	Habit	Conc/m3	Max Size	Habit	
12:51:52	0	0			0	0	0	0	0	0	Fl280 profile descent 6 start
13:00:03											Profile 6 interupted fl200
13:03:30	0	0			0	0	0	0	0	0	Profile 6 resumed fl200
13:09:06											Profile 6 end fl 150
13:09:06	0	0			0	0	0	0	0	0	Start of run 8
13:34	1.1	0.7									
13:35	1.1	0.5									
13:36	0.1	0.1									
13:37	0	0									
13:40:13	0										End of run 8 fl150
13:40:13	0	0			0	0	0	0	0	0	Start of profile 7 fl150
13:41	0	0			0	0	0	0	0	0	
13:46	2.25	2.2			50	125	10				
13:47	2.5	1.9			250	300	1	20000	200		
13:48	1.13	0.96			200	250	1	13000	200		
13:49:40											End of profile 7 fl50

Faults / Incidents Log

Flight No. B087
Date: 30/03/05

Instruments

1. Video – inboard display goes to standby when in use.
2. Intermittent problem with core chemistry headset.
3. Core Chem CO initially not working – cell pressure problems. Temporary fix applied in flight. Progressive degradation in instrument sensitivity. Data from Run 7 onwards invalid at high altitude. Problem traced to input tubing.
4. Cloud Physics unable to access horace data. Rectified in flight.
5. Peroxide MFC failure – attempted to repair in flight.
6. Core Chemistry SO2 flow drops to zero at FL150. Readings invalid above this level.
7. Printer colour cartridge needs replacing.
8. Mission Scientist Laptop unable to print in colour.
9. CNC and FWVS serial link cable missing.
10. ADA not working.
11. Cabin services cable (Weight on wheels) missing from ADA/CPI rack.
12. NOxy Calibration gas not getting through – plumbing problem.

Aircraft

Flight Manager's Instrument Status Log

Flight No. **B**087 Date: 30/03/05

Instrument	Fitted	Operated	Instrument	Fitted	Operated
Navigation			**Cloud Physics**		
INU		**Y**	**Probes**		
GPS		**Y**	FFSSP		**Y**
Satcom C		**Y**	PCASP		**Y**
Satcom H		**Y**	2D-P		**Y**
Thermometers			2D-C		Y
De-Iced Temp		**Y**	Cloudscope	**Y**	**N**
Non De-Iced		**Y**	SID 1		**N**
Heimann		**Y**	SID 2		**Y**
Hygrometers			CPI	N	
G. Eastern		**Y**	HVPS	**N**	
J. Williams		**Y**	**Racks:**		
Nevzorov		**Y**	INC	**N**	
TWC		**Y**	CCN / CNC	**Y**	**N**
FWVS		**N**	CVI	**Y**	**N**
Radiometers					
Upper Clear	**Y**	**Y**	**Aerosol**		
" Red	**Y**	**Y**	PSAP	**N**	
" Silicon	**Y**	**Y**	Nephelometer	**N**	
" JO1D	**N**		Filters	**N**	
Lower Clear	**Y**	**Y**	AMS		**Y**
" Red	**Y**	**Y**			
" Silicon	**Y**	**Y**			
" JO1D	**N**				
Large Radiometers			**Others:**		
TAFTS		**N**	NIR TDLAS		**Y**
MARSS		**N**	2BT O3		**N**
DEIMOS		**N**	VACC		**N**
ARIES		**N**	PEROXIDE		**Y**
SWS		N	Formaldehyde	**Y**	**N**
Chemistry			ADA	**Y**	**N**
Ozone		**Y**	CPI		**Y**
ECGC	**N**		NOxy		**Y**
NOX		**Y**	PTRMS		**Y**
CO		**Y**			
ORAC	**Y**	**N**			
PAN	**Y**	**N**			
PERCA	**Y**	**N**			
WAS	**Y**	**N**			